network must, of course, maintain *some* spare capacity, but the BCM fill assumptions include capacity that exceeds any reasonable needs for providing basic service *or* basic network elements.

Other key omissions and design flaws associated with BCM1 include: its loop design flaws relating to feeder/distribution cable interfaces and distribution loop architecture that result in overestimates of distribution cable and related facilities (and hence costs), *see, supra*, and failure to differentiate between buried and underground cable installations. The net effect of these and other errors is that BCM1, unless carefully corrected and adjusted, significantly overstates the efficient forward-looking costs of supplying loop facilities and provides no real estimates at all of the forward-looking costs of supplying other basic network facilities.

That is not to suggest that BCM1 is without value. BCM1 has important virtues, including an open architecture and publicly verifiable data. Properly corrected, modified, and supplemented as done by Hatfield Associates (and MCI in BCM +), BCM1 can serve as the point of departure for reasonable estimates of the costs of both basic service and basic network elements. But the proper corrections and adjustments must be made, and the proponents of BCM models in this proceeding have steadfastly refused to make the necessary corrections.

(footnote continued from previous page)

> value-added services like caller ID and call waiting. "I think it's sustainable for quite a time," said chief financial officer Ron Dykes. "We have more lines to hang advanced services on and we're hanging more per line than anyone else."

Reuters (Oct. 19, 1995). Likewise, GTE has confirmed that much of its new network capacity in recent years has been acquired *solely* for non-basic service:

> GTE continues to roll out its World Class Network [including] a sophisticated fiber-optics and high-capacity switching infrastructure [and] state-of-the-art voice, video and data products and services [including] the deployment of 60 Asynchronous Transfer Mode ("ATM") switches in 13 states . . . which will bring the latest high-speed voice, video and data switching technology to all of GTE's major markets.

GTE press release, quoted in Business Wire (June 16, 1995).

B. The BCM2 Model

In a professed attempt to make BCM1 more accurate, two of its proponents, US West and Sprint, released a revised version of the model ("BCM2") in July 1996.[35] In fact, the cost estimates generated by BCM2 are even *higher* than those generated by BCM1 and, in many cases, approach or exceed ILEC embedded costs. Significantly, MCI, the only non-LEC sponsor of BCM1, does not endorse BCM2.

Although it addresses in some fashion many (although not all) of BCM1's most serious defects, BCM2 does not even begin to offer adequate solutions. Many shortcomings of BCM1 remain entirely uncorrected. Where BCM2 proposes refinements, they are typically less sophisticated and realistic than those made by the Hatfield model.[36] And the handful of BCM2 refinements that the Hatfield model has not already incorporated are almost certainly insignificant and, in any event, are overwhelmed by the serious defects in BCM2. Indeed, even the sponsors of BCM2 admit that it still does not provide an adequate basis for pricing basic universal telephone service. *See* Ex parte submission of Sprint Corp. and U S WEST, Inc., in CC Docket No. 96-45 (July 3, 1996) at 5 ("Sprint and U S WEST remain convinced that the results of BCM2, by themselves, are not appropriate for the pricing of telephone service").

BCM2 continues to generate inflated and arbitrary estimates of the outside plant required to provide basic residential service. First, with respect to some key facilities, BCM2 continues to apply unrealistic fill and capacity utilization assumptions that produce an oversized (and costly)

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[35] Because both BCM2 and the Pacific Telesis CPM model have appeared only recently, they have not, like the Hatfield Model, been subjected to (and benefited from) the substantial use, testing and approval by state regulators and parties that have allowed the Hatfield Model's developers to identify and correct errors.

[36] Many of these changes are also undocumented and unverifiable. Thus, for example, although BCM2 purports to match Hatfield Release 2's direct estimation of business lines, the BCM2 sponsors do not specify the source of the underlying data, making it impossible to verify or assess the modification.

modeled network designed to reflect ILECs' embedded strategic investments and not an efficient, forward-looking basic telephony network.

Second, the BCM2 design architecture assumptions still produce inflated distribution cable estimates. The model continues to assume, for example, that feeder cable generally ends at the edge of the Census Block Group ("CBG") -- an assumption that arbitrarily inflates capital costs when substituting feeder for distribution cable within the CBG boundary would be a more economical alternative.[37] Inflating loop capital costs in turn leads to inflated estimates of virtually all other cost components through application of the inflexible expense multipliers and other facilities add-ons.

Third, BCM2 improperly assumes that all digital loop carrier ("DLC") facilities will use "non-integrated" technology. This is contrary to efficient forward-looking practices (and, indeed, current ILEC practices), which dictate the use of next generation integrated digital loop carrier technology in many circumstances. Moreover, BCM2 models DLC investments crudely and simplistically. Hatfield, in contrast, models DLC investments from the ground up on a forward-looking basis, and uses next generation IDLC throughout.

Fourth, although BCM2 separately calculates cable and structure costs, Version 2.2 Release 2 of the Hatfield Model does so in a much more sophisticated way. BCM2 uses one of three alternative multipliers (1.2, 1.3, or 1.4) to estimate structure costs as a function of cable costs, and continues improperly to lump buried and underground cable investments together. Hatfield, in contrast, separately calculates buried, underground and aerial structure costs.

BCM2's switching algorithm also continues to stray from the relevant economic costing principles. BCM2 assumes that switches fall into five arbitrary size categories, each with its own arbitrarily assigned fixed and per-line costs:

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37 BCM2 extends feeder into the center of the CBG only when copper limits are reached.

BCM SWITCH COST TABLE		
Lines/Wire Center	*Fixed Cost*	*Per Line Cost*
Remote	$250,000	$100
10,000	400,000	100
60,000	600,000	100
100,000	900,000	100
500,000	1,500,000	100

In contrast, the Hatfield Model estimates switching investment by sizing each switch on the basis of the estimated traffic originating and terminating in each wire center. And unlike BCM2, Hatfield models the investment from the ground up, including land, buildings, power and all other relevant investments.

BCM2 also continues to address many significant costs only through crude add-ons and multipliers. Thus, for example, unlike the Hatfield Model, which sizes and costs investments in interoffice facilities required to provide service on the basis of the amount of traffic between individual wire centers (and a host of other relevant cost drivers), BCM2 simply applies a 3 percent factor to all other investments to estimate the amount of interoffice investment. Similarly, BCM2 makes no attempt to model the costs of the SS7 signaling network. BCM2's treatment of expenses, while an advance over the single multiplier used by BCM1, also remains vastly inferior to the detailed category-by-category analysis of such elements found in Hatfield. In lieu of the separate user-adjustable inputs for asset depreciation lives, cost of capital, tax rates, capital structure and disaggregated forward-looking expense/investment relationships in the Hatfield Model, BCM2 collapses these distinct cost elements into three single-factor multipliers: one for “cable wire” (0.232761), one for “electronics” (0.242411), and one for “switching”

(0.257033). The bases for these values are unexplained, but they are apparently based on historic, embedded investment/expense ratios.[38]

Finally, although BCM2's sponsors tout two areas in which they claim their new model is more sophisticated than the Hatfield Model, neither could conceivably justify ignoring BCM2's many serious deficiencies. First, BCM2 accounts for road locations and places populations within 500 feet of roads in rural areas, concentrating population, and allowing for less distribution investment. Any benefit that might be obtained from this refinement in loop design methodology, however, is plainly overwhelmed by the model design flaws discussed above, which cause BCM2 outputs to greatly overstate economic costs. Second, BCM2 adds additional geographic factors to reflect the supposed cost effects of slope of land and depth of water table. The sponsors of BCM2 have not specified the nature of these adjustments -- and the documentation and justification for the values assumed -- and have offered no evidence that these changes produce significantly more accurate cost estimates. They plainly cannot compensate for BCM2's myriad defects. In sum, contrary to every key criterion of a good model, BCM2 measures the wrong costs, violates fundamental economic cost principles, and could hardly be more inflexible.

[38] In addition to its significant flexibility advantages in the present universal service costing context, the Hatfield Model has the added benefit of allowing regulators to use a single model in carrying out both their universal service and network element pricing responsibilities.

III. COST PROXY MODEL

The CPM, recently released by Pacific Telesis, is the proverbial "black box." It is little more than a spreadsheet on which are collected input values based on proprietary data, undocumented judgments or assumptions, and the outputs of *other* models. Most notably, CPM does not itself develop *any* unit costs -- all such inputs are based on external sources, primarily PacTel itself. Nevertheless, despite the unverifiable nature of much of the CPM model, it is clear that it commits many of the same errors as the BCM models.

Indeed, CPM reflects embedded rather than forward-looking costs to an even *greater* extent than the BCM models. That is because the CPM model purports to calculate universal service costs from unit cost assumptions and engineering practices that are rooted in PacTel's specific local exchange network, rather than upon forward-looking, efficient basic local service practices and technologies.

This fundamental design flaw results in greatly overstated costs. In recent years, PacTel, like other ILECs, has altered its network facilities to provide it with the capabilities to provide advanced narrowband and broadband digital services -- not just POTS. Consistent with their desire to be positioned to provide advanced narrowband and broadband services, ILECs, including PacTel, have installed fiber optic and coaxial rather than copper capacity to a far greater degree than would be optimal for provision of POTS-only service.[39] Yet, the CPM makes no effort to isolate the forward-looking costs of efficiently providing basic service. Instead, it simply

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[39] *See* Testimony of Lee L. Selwyn on behalf of AT&T & MCI before the Public Utilities Commission of California in Docket No. R.95-01-020 (Exh. No. 9).

attributes the embedded network capacity to all existing services in proportion to existing volume.[40]

The CPM model likewise overstates efficient forward-looking costs by using unreasonably low fill factors for many kinds of network plant. Again, these fill factors reflect not necessary spare for basic telephony capacity, but excess capacity added in anticipation of providing advanced narrowband and broadband services. Whether adding excess capacity today is an efficient way to provide such advanced services, it is clearly not an efficient, cost-minimizing way to provide basic network residential service, and such costs have no place in basic residential service subsidy calculations.[41]

PacTel claims that anticipated growth in the demand for second and third residential lines explains some of this spare capacity. Again, however, universal service subsidies can be justified only for basic services over a single residential line per household. And whether or not installing spare capacity for multiple lines sooner, rather than later, makes business sense for PacTel or other ILECs, such capacity cannot be causally attributed to primary residential lines. Rather, those additional costs must be recovered through second and third line charges, not universal service subsidies. The CPM model nonetheless apportions the costs associated with network capacity among primary and additional lines in proportion to *existing* usage of capacity, while totally ignoring the nature of the projected *future* usage that prompted the LEC to install the extra

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[40] One recent empirical study indicates that overall about $25 billion of the embedded RBOC net investment base cannot be explained by grwoth in the demand for basic service. *See* Affidavit of Lee L. Selwyn and Patricia D. Kravtin filed on behalf of AT&T in CC Docket No. 96-98 (May 30, 1996).

[41] *See* Testimony of Lee L. Selwyn in Docket No. R95-01-020, *supra.*

capacity. Unused capacity is implicitly assigned in direct proportion to *embedded* in-service capacity.[42]

The resulting cost misallocation is substantial, and goes beyond the cost of larger capacity cable. For example, the sizing and placement of Service Area Interfaces ("SAIs") is driven by total potential capacity demand, not the number of initially deployed working loops. The proliferation of SAIs in turn will impose additional capacity costs on the feeder cables that connect SAIs with the central office and so on.[43]

Even putting aside the fact that the CPM model measures the wrong costs for universal service purposes, it also contains numerous additional design and application flaws. Thus, for example, the CPM model's inconsistent use of so-called "terrain modifying factors" artificially inflates loop investment costs.[44] Moreover, the regression analyses that were used originally to

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42 Virtually all growth in the residential access line market has come from second and third lines and vertical services. *See* March 19, 1996 Speech of Ray Smith, Bell Atlantic CEO, Merrill Lynch Telecommunications CEO Conference ("Almost all of the growth we see is from households adding second and third lines, accompanied by vertical services such as Answer Call and Caller ID"). In contrast, the demand for primary lines in a neighborhood, once subdivided and built, is stable if not completely flat. *See also supra.*

43 The LEC may also install additional fiber strands and associated electronics (per gain equipment) for SAIs served by fiber, and additional copper feeder capacity to serve the more fragmented SAI architecture. The use of higher capacity (i.e., heavier) distribution cable may also increase the cost of supporting structures, *e.g.*, poles have to be placed closer together (resulting in more poles per unit of distance), and may also have to be reinforced. *See also* Affidavit of AT&T witnesses Selwyn & Kravtin in CC Docket No. 96-98.

44 CPM "Modifying Factors" attempt to reflect the difference between the costs of installing lines in difficult terrain or congestion vs. the costs of installing lines with "minimum costs under normal conditions" -- *i.e.*, without unusual terrain or congestion. The CPM *applies* these factors, however, to cost values based on *average* field conditions for outside plant installation, rather than "minimum costs under normal conditions," which has the effect of double counting terrain impacts.

develop these costs apparently no longer exist, so the cost values are no longer supported or verifiable.[45]

CPM grossly overstates switching costs. CPM bases costs of central office switches and feeder solely on average population density of the grid square, ignoring the number of lines served by the switch (an important determinant of costs). Moreover, switching costs in the CPM do not reflect economies of scale. Indeed, PacTel's own public statements refute the CPM switching cost estimates -- PacTel has publicly stated elsewhere that it could deploy (and, indeed, planned to deploy) digital switch technology for less than one half the $240/line cost estimated by CPM.[46]

The expense factors in the CPM are also flawed. For example, the CPM model employs unrealistically short depreciation lives. These asset life assumptions, which are considerably shorter than the depreciation lives prescribed by state and federal regulators for PacTel (or recommended in the original BCM model), improperly may reflect the lives of assets used to provide advanced narrowband and broadband services -- services that, unlike the relevant basic residential services, may face rapid technological and market obsolescence. Accordingly, the

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45 The CPM develops costs at the level of grid cells within 1/100 of a degree of longitude and latitude (roughly 1/4 mile). Household density within each grid is used to identify the distribution plant to be used. The CPM uses the overall density of the wire center to identify the feeder plant to be used.

46 *See* January 25, 1993, Pacific Bell Press Release (announcing a $1-billion plan to deploy new digital switches and stating that "the new switches will serve 9.1 million lines" with a "[t]otal cost for the project, including purchase of the switches, installation and associated support, [of] just over $1 billion," or approximately $110 per line).

CPM significantly overstates the economic depreciation charges that are likely to be associated with the provision of essential service and basic network elements.[47]

Finally, the CPM allocates to basic service significant costs that are in fact incurred in common with other retail services. Examples of such cost misallocation include the costs of billing inquiries (which the CPM directly identifies as being 100 percent associated with basic service), and the costs of customer inquiries to customer representatives about multiple products. In sum, CPM is completely unverifiable and inflexible, designed to measure the cost of PacTel's existing network, and not an efficient narrowband network, and improperly applies backward-looking, rather than forward-looking designs and costs.

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[47] The CPM cost estimates are also inflated by the inclusion of expenses common between basic and enhanced services which are not properly attributable to basic services under any forward-looking economic costing approach.

CONCLUSION

For the foregoing reasons, AT&T respectfully requests that the Joint Board approve the Hatfield model as a reasonable basis for estimating the costs of basic services and basic network elements. BCM1, BCM2, and CPM, in contrast, are too unreliable and inaccurate to serve this purpose, and the Joint Board should so hold.

Respectfully submitted,

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APPENDIX A

HATFIELD ASSOCIATES MODEL -- RELEASE 2 REFINEMENTS

Hatfield Associates Model Version 2.2, Release 2, reflects the following changes that have been made since the Version 2.2, Release 1 update on May 30, 1996. An automated platform was also added for easier running of model.

I. MODIFICATIONS IN BCM +

A BCM derivative called BCM + has been created by MCI and has been incorporated into the Hatfield Model.

A. Data Module

1. Modified input and output sheets to accommodate separate business line counts per Census Block Group ("CBG").

2. Added test to remove "#N/A" from cable multiplier columns.

3. Added variable number of distribution cables by density range.

4. Added test to increase distribution and subfeeder length in areas with either shallow bedrock (< 12 inches) or rocky soil types.

5. Modified feeder calculation to place SAI inside CBG by a distance equal to 0.25x length of CBG side.

B. Loop module

1. Replaced hard-wired 12,000 foot fiber/copper feeder threshold with user-input variable distance; default value set at 9000 feet.

2. Replaced assumed DS-3 per-fiber capacity limit with user-variable input; default value set at 2016.

3. Replaced assumed four fibers per remote terminal with user-variable input; default value set at 4.

4. Modified lookup tables for optical feeder cable to allow user adjustment of cable sizes; maximum cable size reset at 216 fibers; fiber cable per foot investment adjusted to include engineering, delivery, and installation.

5. Modified lookup table for distribution cable to include 25-pair cable; cable prices adjusted to include engineering, delivery, and installation.
6. Added calculation to reduce individual distribution cable cross section corresponding to variable number of cables by density range.

II. MODIFICATIONS TO OTHER HM MODULES

A. Line Multiplier Module

1. No longer uses multipliers. Business, speical, and public access lines are now allocated to CBGs in proportion to the number of business employees in each census tract. A single 2-line penetration factor is used to estimate residence lines from households.

2. No longer estimates 1990 to 1995 household growth. 1995 household data used in place of 1990 household data.

3. Density zone cost categories have been redefined to be a function of lines per square mile rather than households per square mile.

B. Wire Center Module

1. Eliminated double counting of end office trunk ports.

2. STP size is now scaled by the number of A links in the study area.

3. Calculate C (STP mated Pair) and D (ILEC STP to CLEC STP) link investment -- not just A link investment.

4. Bottoms-up DS0 investment per mile is now estimated for the following routes:

   (a) common (tandem), local, intra LATA and IXC switched access direct transport

   (b) special access

   (Separate user assumptions can now be made for patch panels, optical MUX, regenerator investment and spacing, installation costs, mix of buried/underground/aerial, and manhole and pole spacing.)

5. Eliminated double count of shared structure costs between interoffice and feeder facilities.

6. Reconciled usage calculations between expense and wire center investment modules.

7. Allowed Remote Operator Service positions (user definable).

8. Added IXC switched access direct transport for serving wire center ("SWC") to tandem.

9. Added end office switch traffic limits (previously just limits on lines and busy hour call attempts).

10. Added separate holding time multipliers for business and residence.

C. Convergence Module

1. Estimate structure costs for aerial, buried, underground, poles, conduit and manholes independently of BCM cable investment calculation. Independently treat underground and buried cable. Eliminate double count of terminal/splice. Mix of aerial, buried, and underground user definable for distribution and feeder cable.

2. Estimate DLC investment from ground up to include site, housing, power, engineering, common equipment (including multiplexer at the wire center), and line cards.

3. Correct arithmetic calculation error in local direct and local tandem trunk investment.

4. Change default settings to eliminate optical multiplexers from the Serving Area Interface. Include sufficient fiber capacity to allow dedicated fibers per remote terminal, consistent with current practices.

5. Serving Area Interface (feeder/distribution interface) is located halfway between the boundary and center of the CBG.

6. Second line factor (used for NIDs) previously included 1990 to 1995 household growth; input data now include 1995 household count, and line multipliers now represent second residential line incidence only.

D. Expense Module

1. Economic lives up to 50 years can now be input by user (previous maximum was 32 years).

2. Separate Expense Factors are calculated for the following network elements (only aerial and underground factors were calculated previously):

   (a) Aerial
   (b) Underground

   (c) Buried

   (d) Poles

   (e) Manholes

   (f) Conduit

3. Eliminated double counting of digital line carrier ("DLC ") terminations and end office line circuits.

4. Trunk port costs can now be estimated per DS-0 or per minute.

5. Default user inputs for cost of debt, equity, and debt equity ratio have been changed.

6. Separate uncollectible rates for retail and carrier-to-carrier.

7. Eliminate triple count of NID (other terminal equipment).

8. Drops are now tied to households rather than lines.

9. Reconcile dedicated trunking between wire center and expense modules.

10. Add IXC switched access and local interconnection unit costs to spare sheet.

11. NID expense based on regulated $ per line (other terminal account).

12. Carrier-to-carrier customer service expense added. (User definable; default set to $1.56/line/year.)

13. NID monthly cost calculation added to Loop worksheet.

14. Structure sharing fractions expanded to allow user to set independent parameters for aerial, buried, and underground distribution and feeder.

15. Separate depreciation lives are used for switching and wire center (a composite life had been used previously).

E. Universal Service Module Has Been Added

1. Network cost built up from UNEs.

2. Network Operations factored to reflect local only.

3. LNP costs added.

4. Weighted average cost per line uses households weights rather than total lines.

Input Name		Default
Cost of Capital Factors		
Depreciation Lives		
Loop Distribution		20
Loop Feeder		20
Loop Concentrator		10
Wire Center		37
End Office Switching		14.3
Tandem Switching		14.3
Transport Facilities		19
Operator Systems		8
STP		14
SCP		14
Links		19
Public Telephones		9
General Support		7
Cost of Capital		
Debt Percent		45.00%
Cost of Debt		7.70%
Cost of Equity		11.90%
Equity Percent		*55.00%*
Overall Cost of Capital		*10.01%*
Misc Expense Factors		
Variable Overhead Factor		10.00%
Federal Income Tax Rate		40.00%
Other Taxes Factor		5.00%
Operating State and Local Income Tax Factor		1.00%
Billing/Bill Inquiry per line per month	$	1.22
Directory Listing per line per month	$	0.15
Forward-Looking Network Operations Factor		70.00%
Central Office Switching Expense Factor		2.69%
End Office Traffic-Sensitive Fraction		70.00%
per-line Monthly LNP Cost	$	0.25
Fill Factors		
Cable		
Feeder		
0-5		0.65
5-200		0.75
200-650		0.80
650-850		0.80
850-2550		0.80
2550+		0.80

Distribution		
0-5		0.50
5-200		0.55
200-650		0.60
650-850		0.65
850-2550		0.70
2550+		0.75
EO Switching Parameters		
Busy hour call attempts, residential		1.3
Busy hour call attempts, business		3.5
Switch Maximum Line Size		100,000
Switch Maximum Line Fill		0.80
Switch Maximum Processor Occupancy		0.90
Processor Feature Loading Multiplier		1.00
Switch Installation Multiplier		1.10
Switch Parameters		
Switch real-time limit, BHCA		
1 - 1,000		10,000
1,000 - 10,000		50,000
10,000 - 40,000		200,000
40,000+		600,000
Switch traffic limit, BHCCS		
1 - 1,000		10,000
1,000 - 10,000		50,000
10,000 - 40,000		500,000
40,000+		1,000,000
Switch cost points	*lines*	
Low line size		2,782
Mid line size		11,200
High line size		80,000
	cost/line	
Low line size	$	220.00
Mid line size	$	86.00
High line size	$	59.00
Residential Holding Time Multiplier		1.00
Business Holding Time Multiplier		1.00
Interoffice and Tandem Parameters		
Operator Traffic Fraction		0.02
Total Interoffice Traffic Fraction		0.65
Direct-Routed Fraction of Local Interoffice		0.98
Maximum Trunk Occupancy, CCS		27.5
Trunk Termination Investment, per end	$	100
Average Direct Route Distance, miles		10

Average Trunk Usage Fraction		0.3
Toll traffic inputs		
Tandem-routed % of total intraLATA traffic		0.2
Average direct intraLATA route distance, mi.		25
Tandem-routed % of total interLATA traffic		0.2
Average direct access route distance, mi.		15
Tandem Switching parameters		
real time limit, BHCA		1,500,000
port limit, trunks		120,000
common equipment investment	$	1,000,000
maximum trunk fill		0.8
maximum real time occupancy		0.9
common equipment intercept factor		0.25
Wire Center Parameters		
Lot size, multiplier of switch room size		2
Tandem/EO wire center common factor		0.40
Power and frame investment	*sum of power & frame*	
0	$	10,000
1,000	$	20,000
5,000	$	40,000
25,000	$	100,000
50,000	$	500,000
Switch Room size table	*floor area required*	
0		500
1,000		1000
5,000		2000
25,000		5000
50,000		10000
Construction costs, per sq ft	*construction/$/sq ft*	
0	$	75
1,000	$	85
5,000	$	100
25,000	$	125
50,000	$	150
Land price, per sq ft	*price/sq ft*	
0	$	5.00
1,000	$	7.50
5,000	$	10.00
25,000	$	15.00
50,000	$	20.00
Distribution Structure Inputs		

Aerial Fraction		
0-5		0.5
5-200		0.5
200-650		0.5
650-850		0.5
850-2550		0.4
2550+		0.65
Buried Fraction		
0-5		0.5
5-200		0.5
200-650		0.5
650-850		0.5
850-2550		0.5
2550+		0.05
Underground Fraction		
0-5		*0*
5-200		*0*
200-650		*0*
650-850		*0*
850-2550		*0.1*
2550+		*0.3*
Buried Installation/foot		
0-5	$	2.00
5-200	$	2.00
200-650	$	2.00
650-850	$	3.00
850-2550	$	3.00
2550+	$	20.00
Conduit Installation/foot		
0-5	$	25.00
5-200	$	25.00
200-650	$	25.00
650-850	$	25.00
850-2550	$	45.00
2550+	$	70.00
Pole spacing, feet		150
Pole investment	$	450
Conduit investment per foot	$	1.00
Manhole investment, per manhole	$	3,000
Buried cable armoring multiplier		1.1
Copper Feeder Structure Inputs		
Aerial Fraction		
0-5		0.5

5-200		0.5
200-650		0.5
650-850		0.4
850-2550		0.1
2550+		0.05
Buried Fraction		
0-5		0.45
5-200		0.45
200-650		0.45
650-850		0.4
850-2550		0.1
2550+		0.05
Underground Fraction		
0-5		*0.05*
5-200		*0.05*
200-650		*0.05*
650-850		*0.2*
850-2550		*0.8*
2550+		*0.9*
Buried Installation/foot		
0-5	$	2.00
5-200	$	2.00
200-650	$	2.00
650-850	$	3.00
850-2550	$	3.00
2550+	$	25.00
Conduit Installation/foot		
0-5	$	25.00
5-200	$	25.00
200-650	$	25.00
650-850	$	25.00
850-2550	$	45.00
2550+	$	75.00
Manhole Spacing, ft.		
0-5		800
5-200		800
200-650		800
650-850		800
850-2550		600
2550+		400
Pole spacing, feet		150
Pole investment	$	450
Conduit investment per foot	$	1.00
Manhole investment, per manhole	$	3,000
Buried cable armoring multiplier		1.1

Fiber Feeder Structure Inputs	
Aerial Fraction	
0-5	0.35
5-200	0.35
200-650	0.35
650-850	0.2
850-2550	0.1
2550+	0.05
Buried Fraction	
0-5	0.6
5-200	0.6
200-650	0.6
650-850	0.6
850-2550	0.1
2550+	0.05
Underground Fraction	
0-5	*0.05*
5-200	*0.05*
200-650	*0.05*
650-850	*0.2*
850-2550	*0.8*
2550+	*0.9*
Buried Installation/foot	
0-5	$ 2.00
5-200	$ 2.00
200-650	$ 2.00
650-850	$ 3.00
850-2550	$ 3.00
2550+	$ 20.00
Conduit Installation/foot	
0-5	$ 25.00
5-200	$ 25.00
200-650	$ 25.00
650-850	$ 25.00
850-2550	$ 45.00
2550+	$ 70.00
Manhole Spacing, ft.	
0-5	2,000
5-200	2,000
200-650	2,000
650-850	2,000
850-2550	2,000
2550+	2,000

Buried cable armoring per foot, fiber	$	0.20
Misc Loop Investment Inputs		
Drop investment per line	$	40.00
NID investment per line	$	30.00
Terminal and splice per line	$	35.00
Average lines per business location		4
Feeder structure fraction shared w/ interoffice		0.25
Distribution structure % assigned to telephone		
aerial		0.33
buried		0.5
underground		0.33
Feeder structure % assigned to telephone		
aerial		0.33
buried		0.5
underground		0.33
SAI Investment, installed		
Distribution cable size		*copper feeder*
0	$	500.00
100	$	700.00
200	$	900.00
400	$	1,100.00
600	$	1,300.00
900	$	1,500.00
1200	$	1,700.00
1800	$	1,900.00
2400	$	2,100.00
3000	$	2,300.00
3600	$	2,500.00
Distribution cable size		*fiber feeder*
0	$	2,500.00
100	$	2,700.00
200	$	2,900.00
400	$	3,100.00
600	$	3,300.00
900	$	3,500.00
1200	$	3,700.00
1800	$	3,900.00
2400	$	4,100.00
3000	$	4,300.00
3600	$	4,500.00
Digital Loop Carrier Inputs		
SLC (TR-303)		
site, housing, and power per remote terminal	$	3,000.00

maximum lines		672
remote terminal fill factor		0.9
common equipment investment	$	42,000.00
channel unit investment per line	$	75.00
DS-0s per fiber		2,016
Fibers per remote terminal		4
AFC		
site, housing, and power per remote terminal	$	2,500.00
maximum lines		100
remote terminal fill factor		0.9
common equipment investment	$	10,000.00
channel unit investment per line	$	150.00
DS-0s per fiber		2,016
Fibers per remote terminal		4
Fiber feeder distance threshold, ft. (feeder length)		9,000
Signaling Parameters		
STP Link Capacity		720
STP Maximum Fill		0.8
STP Investment, per pair, fully equipped	$	5,000,000
STP common equipment investment, per pair	$	1,000,000
Link Termination, both ends	$	900.00
Signaling Link Bit Rate		56,000
Link Occupancy		0.4
C Link Cross-Section		24
ISUP messages per interoffice BHCA		6
ISUP message length, bytes		25
TCAP messages per transaction		2
TCAP message length, bytes		100
Fraction of BHCA requiring TCAP		0.1
SCP investment per transaction per second	$	20,000.00
Misc Inputs		
Operator position parameters		
Investment per position	$	3,500.00
Maximum utilization per position, CCS		27
Operator intervention factor		10
Operator position remote distance, mi.		0
Other		
DS0/DS1 crossover		24
DS1/DS3 crossover		28
Public Telephone investment per station	$	1,200.00
Transport Investment		

Terminal Investment		
Number of Fibers		24
FOT capacity, DS-3s		12
FOT fill		0.8
FOT, installed	$	43,000.00
Pigtails	$	60.00
Panel	$	1,000.00
EF&I, per hour	$	55.00
Medium Investment		
Fraction of structure assigned to telephone		0.33
Fraction of structure shared with feeder		0.33
Regenerator spacing, mi.		40
Regenerator investment, installed	$	15,000.00
Fiber Cable investment per foot	$	2.00
Placement	$	2.00
Splice Spacing, ft.		20,000
Splice Cost	$	15.00
Trenching per foot	$	45.00
Resurfacing per foot	$	10.00
Conduit per foot	$	4.00
Number of tubes		2
Manhole investment	$	5,000.00
Manhole spacing		1,000
Buried installation per foot	$	5.00
Pole investment		450
Pole spacing		150
Underground percent		35.00%
Buried percent		50.00%
Aerial percent		15.00%